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EFFECT OF 1- METHYL CYCLOPROPENE CONCENTRATION STORAGE TIME AND TEMPERATURE, ON POSTHARVEST QUALITY AND SHELFLIFE OF TOMATO FRUIT

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ABSTRACT

The present research was undertaken to study the effect of 1-Methyl Cyclopropene (1-MCP) on quality and shelf life of tomato fruits (Cv. US-440). Freshly harvested matured tomato fruits were selected and treated with fungicide at 500 µl˙L for 10 min. The fruits were then exposed to different concentrations of 1-methylcyclopropene viz. 0.5, 1.0, 1.5 and 2.0 µl˙L at 20˚C for 12 and 24 hrs (hr) respectively in an airtight chamber and then stored at different temperature viz. 20˚C and ambient temperature (25-28ºC). The present study revealed that the fruits treated with 1-MCP at 2 µl˙L concentration exposed for 24 hr at 20˚C storage temperature found higher shelf life of 33 days along with better physicochemical changes like lower percent physiological loss in weight (%PLW), increase in Total Soluble Solids, least surface color development, decreased Percent titrable acidity and ascorbic acid content, as compared to control fruits and rest of the treatments, respectively.

KEYWORDS: Tomato, Fungicide, 1-MCP & Shelf life

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Original Article

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is a major horticultural crop with an estimated global production of over 223 million metric tons (1). It is one of the most important vegetable crops cultivated all over the world for its fleshy fruits. Consumer's increasing desire for high quality and nutritional foods has created a need for longer market season for both domestic as well as export markets. Optimum quality is attained through vine ripening. But, ripe tomatoes are perishable and very labile to shipping damage which consequently leads to loss of quality and waste (2). Ethylene plays a key role in the ripening of climacteric fruits such as tomatoes by triggering several ripening related physiological changes and its ripening is highly depended on ethylene action (3). Ethylene is effective for the ripening and senescence of climacteric fruits and other horticultural commodities. (3,4) and the use of ethylene inhibitors for delaying the ripening is common practice now a days (5,6,7). 1-methylcyclopropene (1-MCP) has been intensively researched and used as ethylene inhibitor (8,9) due to its approved feasible commercial use, easy application, and high efficacy with a large number of horticultural crops. 1-MCP exposure is treated in the form of gas in sealed containers (10). Hence, a non-sophisticated technology to extend tomato shelf life at ambient and low temperature storage conditions with minimal impacts to the environment is needed to increase the competitiveness of this commodity on the global market. The present investigation was therefore undertaken to study the effects of 1-MCP on physicochemical changes and shelf life of tomato fruit.

MATERIAL AND METHODS

The fresh tomato fruits of cultivar US-440 was harvested and divided in to different stage of physiological maturity i.e green, pink and break stage. Fruits at the proper stage of physiological maturity (green and pink stage) were selected from well-managed commercial farms then the fruits were washed thoroughly with clean water and then prepared for the treatments.

1-MCP treatment

The fruits harvested at proper stage of maturity were selected, washed, and graded on the basis of their specific gravity and given the fungicidal treatment of 500 µl¯L. The tomato fruits were then subjected to 1-MCP treatment in airtight chamber at various concentrations viz. 0.5, 1.0, 1.5 and 2.0 µl¯L. respectively along with absolute control. The fruits were exposed to 1-MCP for the different period of exposure time i.e 12 and 24 hr and then stored at different temperature i.e at ambient temperature and at 20 $^{\circ}$C.The fruits were then evaluated for various physico-chemical characteristics like Titrable acidity, Ascorbic acid content, Percent physiological loss in weight of fruit (PLW), Colour (^{o}h), Total soluble solids and shelf life of fruit.

Physiological loss in weight (%)

Physiological loss in weight of fruits was calculated by using analytical weighing balance to determine the degree of maturity during the storage of 1-MCP treated and control fruit samples (11).

Colour Measurement

Colour value (A) and (B) was determined using a Minolta Colourimeter (Model-CR- 10 and Konica Colourimeter, Japan) with a standard CIE illuminant by calculating the hue angle using formula Tan^{-1}.(B/A).

Total Soluble Solids (%)

The total soluble solids (%) in the tomato recorded by Agato digital Pocket Refractometer PAL-3 (12) and expressed in percentage.

Titrable acidity(%)

Acidity was determined by titrating known volume of tomato juice with 0.1N sodium hydroxide (13). The percent titratable acidity was expressed in terms of standard ascorbic acid.

Total Ascorbic Acid content (mg/100g)

Total ascorbic acid content was determined by 2, 6 dichlorophenol-indophenol visual titration method in which the dye, which is blue in alkaline solution and red in acid solution, is reduced by ascorbic acid to colourless form. The reaction is quantitative and practically specific for ascorbic acid solution in pH range 1.0-3.5 (13).

Statistical analysis

The readings for every parameter were taken in triplicates for a particular treatment, they were analyzed separately and the figures were then averaged for calculation of standard deviation of each value of every treatment. (14).

RESULTS AND DISCUSSION

Exposure to gaseous 1-MCP at different concentrations of (0.5, 1.0, 1.5 and 2.0 µl/L respectively) slowed down the ripening of tomato fruits and shelf life was increased effectively as the concentration of 1-MCP was increased. The rate of physiological loss in weight of fruit was decreased with increase in 1-MCP concentration, total soluble solids increased with increase in 1-MCP concentration, the rate of change in colour in terms of hue angle (^{o}h) of tomato fruit was improved with increase in the exposure time and concentration of 1-MCP but the rate of reduction in the ascorbic acid content and titrable acidity of fruit was decreased with increase in the exposure time and concentration of 1-MCP.

Table 1: Treatment Details of 1-Mcp concentration its Exposure Time and Storage Temperature of Fruit

Treatment	1-MCP Treatments
T_0	Control Fruits (Tomato Cv. US-440)
T_1	1-MCP at 0.5 µl/L + 24 hr exposure time+ 20 ^{o}C storage temperature
T_2	1-MCP at 1 µl/L + 24 hr exposure time + 20 ^{o}C storage temperature
T_3	1-MCP at 1.5 µl/L + 24 hr exposure time + 20 ^{o}C storage temperature
T_4	1-MCP at 2 µl/L + 24 hr exposure time + 20 ^{o}C storage temperature
T_5	1-MCP at 0.5 µl/L + 24 hr exposure time + Room temperature
T_6	1-MCP at 1 µl/L + 24 hr exposure time + Room temperature
T_7	1-MCP at 1.5 µl/L + 24 hr exposure time + Room temperature
T_8	1-MCP at 2 µl/L + 24 hr exposure time + Room temperature
T_9	1-MCP at 0.5 µl/L + 12 hr exposure time + 20 ^{o}C storage temperature
T_{10}	1-MCP at 1 µl/L + 12 hr exposure time + 20 ^{o}C storage temperature
T_{11}	1-MCP at 1.5 µl/L + 12 hr exposure time + 20 ^{o}C storage temperature
T_{12}	1-MCP at 2 µl/L + 12 hr exposure time + 20 ^{o}C storage temperature
T_{13}	1-MCP at 0.5 µl/L + 12 hr exposure time + Room temperature
T_{14}	1-MCP at 1 µl/L + 12 hr exposure time + Room temperature
T_{15}	1-MCP at 1.5 µl/L + 12 hr exposure time + Room temperature
T_{16}	1-MCP at 2 µl/L + 12 hr exposure time + Room temperature

Table 2: Effect of Different Concentrations of 1-MCP Treatment, Exposure Time and Temperature on the Titrable Acidity of Tomato Fruit (%)

Treatments	Storage Period in Days											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0	0.49 ± 0.01	0.26 ±0.02	0.13±0.05	0.17 ± 0.04	0.17 ± 0.03	*	*	*	*	*	*	*
T_1	0.38 ± 0.06	0.32 ±0.04	0.08 ±0.02	0.25± 0.03	0.23 ±0.04	0.21 ± 0.01	0.19±0.01	0.18 ±0.02	0.14±0.04	*	*	*
T_2	0.41± 0.03	0.31± 0.06	0.06± 0.07	0.29± 0.07	0.28± 0.08	0.26±0.03	0.24± 0.04	0.23± 0.06	0.21± 0.07	0.19± 0.07	*	*
T_3	0.49± 0.07	0.40± 0.01	0.10± 0.06	0.37± 0.07	0.33± 0.03	0.32±0.06	0.29± 0.04	0.26± 0.05	0.26±0.02	0.19± 0.01	0.12±0.03	*
T_4	0.46±0.05	0.42± 0.04	0.10±0.02	0.38± 0.05	0.36± 0.07	0.34±0.04	0.33± 0.01	0.30± 0.06	0.24± 0.02	0.23±0.01	0.17±0.03	0.14± 0.05
T_5	0.40±0.04	0.33±0.02	0.26±0.02	0.21±0.05	0.12±0.01	*	*	*	*	*	*	*
T_6	0.38±0.03	0.3±0.05	0.24±0.03	0.21±0.04	0.18±0.01	0.11±0.09	*	*	*	*	*	*
T_7	0.34±0.04	0.26±0.04	0.23±0.02	0.22±0.01	0.19±0.05	0.15±0.03	0.13±0.01	0.1±0.04	*	*	*	*
T_8	0.4±0.03	0.28±0.02	0.28±0.08	0.27±0.07	0.24±0.05	0.21±0.05	0.19±0.03	0.16±0.02	0.11±0.01	*	*	*
T_9	0.39± 0.02	0.34±0.01	0.3±0.01	0.27±±0.02	0.21±0.01	0.17±0.08	0.12±0.02	0.1±0.02	*	*	*	*
T_{10}	0.47±0.02	0.41±0.05	0.38±0.01	0.32±0.03	0.27±0.02	0.23±0.05	0.19±0.04	0.15±0.03	0.12±0.04	0.1±0.02	*	*
T_{11}	0.41±0.04	0.38±0.03	0.35±0.04	0.32±0.02	0.27±0.01	0.246±0.02	0.22±0.02	0.2±0.01	0.15±0.02	*	*	*
T_{12}	0.51±0.06	0.47±0.01	0.44±0.05	0.42±0.03	0.41±0.02	0.38±0.01	0.37±0.02	0.32±0.01	0.27±0.02	0.23±0.04	*	*
T_{13}	0.40±0.02	0.36±0.01	0.31±0.04	0.25±0.05	0.17±0.03	*	*	*	*	*	*	*
T_{14}	0.43±0.04	0.38±0.09	0.36±0.06	0.24±0.03	0.15±0.01	0.10±0.01	*	*	*	*	*	*
T_{15}	0.42±0.05	0.36±0.01	0.32±0.02	0.26±0.07	0.19±0.03	0.14±0.02	0.13±0.02	*	*	*	*	*
T_{16}	0.51±0.09	0.46±0.03	0.32±0.04	0.24±0.01	0.21±0.05	0.15±0.02	0.19±0.03	0.15±0.02	*	*	*	*

Each value is the average of three determinations and expressed as Mean±SD.

* Spoiled/Not suitable for estimation

T_0: Control $T_1$to T_{16}: 1-MCP Treatment

Table 2 indicates that tomato fruits treated with 1-MCP at 2.0µl/L concentration exposed for 24 hr at 20^{o}C storage

temperature found highest shelf life of 33 days, along with significant decrease in titrable acidity from 0.46 to 0.14% as compared to the rest of treatments of 0.5,1.0,1.5µl/L concentration for 24 hr exposure time at 20 ^{o}C and control fruits.

Table 3: Effect of Different Concentrations of 1-MCP Treatment, Exposure Time And Temperature on the Ascorbic Acid Content of Tomato Fruit (Mg/100g)

Treatments	Storage Period in Days											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0	74.1±2.3	68.93±1.3	53.11±2.0	27.12±2.2	20.34±2.0	*	*	*	*	*	*	*
T_1	73.4±2.7	63.7±1.3	58.76±1.8	51.98±1.3	46.33±1.2	39.55±2.3	33.9±1..9	25.99±2.3	21.47±2.3	*	*	*
T_2	67.9±1.8	61.7±1.31.9	57.6±.4	55.37±2.1	49.72±2.8	45.2±1.7	41.81±1.0	37.29±2.1	32.77±2.5	19.21±1.7	*	*
T_3	71.3±2.5	64.6±1.8	60.5±1.1	57.63±1.4	53.11±1.0	46.33±1.5	44.07±2.1	36.16±2.9	31.64±1.1	27.12±2.0	21.47±1.35	*
T_4	69.4±1.5	64.7±1.3	59.89±1.9	54.24±0.7	50.85±1.7	44.07±0.9	40.68±1.1	35.03±1.0	29.38±1.6	26.5±2.3	23.73±1.6	20.7±1.0
T_5	72.32±1.0	65.54±1.7	48.59±1.3	41.81±1.9	25.5±2.3	*	*	*	*	*	*	*
T_6	74.58±2.9	68.93±1.2	51.98±1.1	45.2±1.7	37.29±2.0	23.2±2.1	*	*	*	*	*	*
T_7	72.32±1.8	68.93±1.1	55.37±1.5	47.46±1.0	42.94±2.1	36.16±2.5	30.51±2.1	21.9±2.0	*	*	*	*
T_8	68.93±2.0	66.67±2.1	49.72±1.7	44.07±1.1	40.68±1.1	37.29±1.0	35.03±1.6	31.64±1.9	24.1±2.1	*	*	*
T_9	68.3±2.0	51.5±1.4	44.6±1.9	36.5±1.4	31.3±1.1	24.8±1.0	21.2±1.3	18.8±1.1	*	*	*	*
T_{10}	73.1±1.4	68.3±1.3	60.7±1.1	55.8±0.9	51.6±1.3	40.7±1.1	35.9±1.7	28.6±1.5	24.1±1.1	20.3±1.6	*	*
T_{11}	69.7±1.1	64.8±1.5	60.3±1.8	54.7±1.7	49.8±1.1	45.7±1.9	36.6±1.5	30.1±1.3	23.5±1.8	*	*	*
T_{12}	70.2±1.0	66.4±1.4	61.7±1.7	56.3±1.9	48.9±2.0	45.1±1.7	38.5±1.1	33.1±1.0	27.3±1.9	20.7±1.2	*	*
T_{13}	65.8±1.1	47.3±1.7	38.8±2.1	29.4±1.3	19.5±2.1	*	*	*	*	*	*	*
T_{14}	69.3±2.0	52.8±1.9	43.7±1.3	36.8±1.9	28.4±1.4	20.8±1.8	*	*	*	*	*	*
T_{15}	67.9±1.0	55.3±1.1	40.6±1.9	33.8±2.0	26.8±2.1	23.9±2.5	18.6±1.0	*	*	*	*	*
T_{16}	70.3±1.1	63.5±1.7	53.4±1.0	47.3±2.1	39.8±2.0	33.4±2.1	27.6±2.0	22.1±1.9	*	*	*	*

Each value is the average of three determinations and expressed as Mean±SD.

* Spoiled/Not suitable for estimation

T_0: Control $T_1$to T_{16}: 1-MCP Treatment

Table 3 indicates that tomato fruits treated with 1-MCP at 2.0µl/L concentration exposed for 24 hr at 20^{o}C storage temperature found highest shelf life of 33 days along with gradual decrease in ascorbic acid content from 69.4 to 20.7 mg/100g as compared control and rest of the treatments. Similar observations trend of results was observed by (15).

Table 4: Effect of Different Concentrations of 1-MCP Treatment, Exposure Time and Temperature on Colour of Tomato Fruit (^{O}h)

Treatments	Storage Period in Days											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0	-3.45 ±1.8	0.54 ±0.2	1.12 ± 0.7	1.12 ±1.3	1.19 ±1.1	*	*	*	*	*	*	*
T_1	-3.36 ±1.3	0.8 ±0.9	1.59 ±1.4	1.59 ±1.3	1.56 ±0.4	1.89 ±1.3	0.24 ±1.1	2.53 ±0.7	2.45 ±0.66	*	*	*
T_2	-6.75 ±2.1	1.89 ±0.5	2.93 ±0.82	2.93 ±1.52	2.68 ±1.92	3.09 ± 1.5	3.38 ±1.4	3.02 ±0.6	3.2 ±0.2	3.23 ±0.4	*	*
T_3	-3.2 ±1.1	2.16 ±1.9	2.42 ±1.3	2.42 ±0.6	2.67 ±0.7	2.91 ±1.4	3.06 ±1.3	3.2 ±1.1	3.31 ±0.8	3.01 ±0.3	3.01 ±1.1	*
T_4	-3.29 ± 1.4	2.48 ±1.8	3.03 ±1.5	3.03 ±1.7	1.71 ±1.0	3.07 ±1.1	3.27 ±0.8	3.3 ±0.11	3.27 ±1.0	3.33 ±0.5	3.4 ±0.5	3.57 ±1.4
T_5	-3.1 ±1.9	1.23 ±0.9	2.52 ±0.4	2.8 ±0.7	3.56 ±0.7	3.89 ±0.15	3.91 ±0.19	*	*	*	*	*
T_6	-3.32 ±1.5	1.34 ±1.9	1.69 ±1.1	2.16 ±1.4	2.59 ±1.0	2.8 ±0.4	3.32 ±0.9	3.52 ±0.3	*	*	*	*
T_7	-3.99 ±0.04	1.49 ±1.1	1.79 ±1.7	1.96 ±0.5	2.22 ±1.7	2.77 ±.1.0	3.4 ±1.1	3.78 ±1.9	*	*	*	*
T_8	-2.67 ±1.5	2.53 ±1.7	2.73 ±1.1	3.09 ±1.8	3.44 ±1.3	3.47 ±0.9	3.55 ±0.4	3.68 ±0.1	3.77 ±0.4	*	*	*
T_9	-3.86 ±0.1	-1.95 ±2.0	0.59 ±1.4	1.98 ±0.2	2.18 ±0.1	2.86 ±1.0	3.1 ±1.7	3.36 ±1.3	*	*	*	*
T_{10}	-7.37 ±1.0	-3.96 ±1.4	0.87 ±1.9	1.68 ±1.2	2.18 ±0.9	2.96 ±0.6	3.19 ±0.4	3.29 ±1.1	3.31 ±0.7	*	*	*
T_{11}	-5.72 ±1.9	-1.73 ±1.5	0.92 ±1.9	1.79 ±1.1	2.48 ±1.3	2.89 ±1.1	3.05 ±1.0	3.17 ±0.4	3.25 ±0.7	*	*	*
T_{12}	-6.74 ±1.1	-2.68 ±1.9	-1.78 ±1.5	0.79 ±0.3	1.73 ±0.9	2.1 ±1.4	2.59 ±0.9	2.89 ±1.0	3.01 ±1.1	3.37 ±1.3	*	*
T_{13}	-2.48 ±0.8	1.48 ±0.4	2.017 ±0.9	2.86 ±1.1	3.39 ±1.0	*	*	*	*	*	*	*
T_{14}	-3.47 ±0.7	1.1 ±0.4	1.78 ±0.8	2.19 ±0.3	2.76 ±1.1	3.19 ±0.9	*	*	*	*	*	*
T_{15}	-1.93 ±0.9	0.38 ±0.1	1.18 ±0.5	1.98 ±0.8	2.38 ±0.2	2.8 ±0.1	3.23 ±1.1	*	*	*	*	*
T_{16}	-4.72 ±0.7	-1.89 ±0.7	0.79 ±1.1	1.98 ±1.4	2.83 ±0.5	3.01 ±0.9	3.19 ±1.1	3.30 ±0.7	*	*	*	*

Each value is the average of three determinations and expressed as Mean±SD.

* Spoiled/Not suitable for estimation

T_0: Control $T_1$to T_{16}: 1-MCP Treatment

Table 4 shows that, the tomato fruits treated with 1-MCP at 2.0µl/L concentration exposed for 24 hr at 20^{o}C storage temperature found highest shelf life of 33days, along with significant decrease in colour (^{o}h) from -3.29 to 3.57 as compared to the another treatments. Similar results were obtained by (16).

Table 5: Effect of Different Concentrations of 1-MCP Treatment, Exposure Time and Temperature on Total Soluble Solids of Tomato Fruit (%)

Treatments	Storage Period in Days											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0	1.4 ±0.3	1.6 ±0.1	1.8 ±0.1	2.9 ±0.1	3.3 ±0.1	*	*	*	*	*	*	*
T_1	1.2 ±0.2	1.5 ±0.3	1.3 ±0.9	1.6 ±0.9	1.6 ±0.1	1.7 ±0.3	2.1 ±0.5	2.5 ±0.8	3.7 ±0.1	*	*	*
T_2	1.6 ±0.5	1.4 ±0.1	1.3 ±0.5	1.5 ±0.6	1.9 ±0.2	2.2 ±0.8	2.1 ±0.9	2.2 ±0.2	2.4 ±0.4	3.2 ±0.5	*	*
T_3	1.4 ±0.4	1.5 ±0.8	1.7 ±0.7	1.9 ±0.4	1.7 ±0.8	2.1 ±0.4	2.3 ±0.1	2.4 ±0.1	2.5 ±0.6	2.7 ±0.1	3.4 ±0.7	*
T_4	1.3 ±0.1	1.2 ±0.6	1.4 ±0.3	1.3 ±0.9	1.8 ±0.6	1.4 ±0.9	1.7 ±0.3	2.2 ±0.5	2.3 ±0.1	2.5 ±0.9	2. 4 ±0.3	3.1 ±0.4
T_5	1.3 ±0.9	1.7 ±0.1	2.1 ±0.2	2.3 ±0.4	2.8 ±0.1	*	*	*	*	*	*	*
T_6	1.5 ±0.7	1.8 ±0.9	2.1 ±0.9	2.2 ±0.1	2.4 ±0.9	3.7 ±0.9	*0.4	*	*	*	*	*
T_7	1.4 ±0.3	1.6 ±0.6	1.7 ±0.5	1.9 ±0.8	2.1 ±0.2	2.4 ±0.1	2.7 ±0.1	3.9 ±0.4	*	*	*	*
T_8	1.1 ±0.7	1.3 ±0.2	1.3 ±0.2	1.5 ±0.5	1.5 ±0.5	1.7 ±0.4	2.2 ±0.9	2.3 ±0.5	3.4 ±0.8	*	*	*
T_9	1.4 ±0.5	1.6 ±0.7	2.1 ±0.8	2.5 ±0.1	2.7 ±0.5	2.9 ±0.4	2.7 ±0.3	3.3 ±0.5	*	*	*	*
T_{10}	1.3 ±0.9	1.4 ±0.9	1.9 ±0.5	2.2 ±0.9	2.4 ±0.2	2.6 ±0.7	2.6 ±0.2	2.7 ±0.1	3.4 ±0.1	*	*	*
T_{11}	1.3 ±0.9	1.5 ±0.1	1.7 ±0.5	1.8 ±1.1	2.1 ±0.6	2.2 ±0.4	2.5 ±0.6	2.4 ±0.8	2.9 ±0.4	*	*	*
T_{12}	1.2 ±0.8	1.4 ±0.2	1.5 ±0.2	1.8 ±0.4	2 ±0.4	2.1 ±0.3	2.3 ±0.1	2.5 ±0.6	2.5 ±0.1	3.6 ±0.5	*	*
T_{13}	1.3 ±0.7	1.6 ±0.8	1.8 ±0.9	2.5 ±0.3	3.4 ±0.1	*	*	*	*	*	*	*
T_{14}	1.4 ±0.7	1.7 ±0.8	1.7 ±0.4	1.9 ±0.8	2.5 ±0.2	2.9 ±0.3	*	*	*	*	*	*
T_{15}	1.3 ±0.2	1.5 ±0.5	1.9 ±0.7	2 ±0.2	2.2 ±0.5	2.5 ±0.1	3 ±0.3	*	*	*	*	*
T_{16}	1.4 ±0.5	1.3 ±0.1	1.4 ±0.1	1.7 ±0.7	1.9 ±0.4	2.2 ±0.3	2.5 ±0.5	3.1 ±0.3	*	*	*	*

Each value is the average of three determinations and expressed as Mean±SD.

* Spoiled/Not suitable for estimation

T_0: Control $T_1$to T_{16}: 1-MCP Treatment

Table 5 shows that, tomato fruits treated with 1-MCP at 2.0µl/L concentration exposed for 24 hr at 20 ^oC storage temperature found highest shelf life of 33 days, along with gradual increase in TSS (%) from 1.3 to 3.1%, as compared to the rest of treatments given to the ethylene untreated fruit at 0.5,1.0,1.5µl/L concentration, for 24 hr exposure time, at 20 ^0C and control fruit in which TSS (%) was increased from 1.2 to 3.7, 1.6 to 3.2, 1.4 to 3.6 and 1.4 to 3.3% in 24,27 and 30 days, respectively. Results were found in close approximity with results obtained by (17).

Table 6: Effect of Different Concentrations of 1-MCP Treatment, Exposure Time and Temperature On Percent Physiological Loss in Weight of Tomato Fruit (%)

Treatments	Storage Period in Days											
	0	3	6	9	12	15	18	21	24	27	30	33
T_0	0	3.8 ±.44	5.7± 0.9	7.9± 0.89	11.3±1.19	*	*	*	*	*	*	*
T_1	0	3±.49	4.7± 0.73	4.9± 1.38	6.1± 1.33	7.4±1.63	8.2±1.44	8.9± 1.29	9.3± 1,49	*	*	*
T_2	0	2.7±.37	4.4± 0.22	5.8± 1.88	6.1± 1.98	6.6± 1.24	7.5±1.39	7.9± 1.92	8.4± 1.52	9.9±1.79	*	*
T_3	0	2.1±.31	3± 0.35	3.9±1.22	4.6± 1.59	5.5± 1.49	5.98±1.99	6.7±1.47	6.8± 1.30	9.2±1.68	10.1± 1.11	*
T_4	0	1.9±.41	2.4± 0.19	2.9± 0.81	3.3± 1.36	3.9± 1.72	4.7± 1.59	5.1± 1.92	5.7± 1.60	6.1±1.39	6.7± 1.13	7.4± 1.11
T_5	0	3.4±.44	6.7± 0.36	8.9± 0.39	11.3±1.34	*	*	*	*	*	*	*
T_6	0	3.1±.43	5.6± 0.77	7.7±1.44	9.1± 1.00	10.6± 1.37	*	*	*	*	*	*
T_7	0	2.7±.39	4.8± 0.89	6.2± 0.29	8.2± 2.1	9.3± 1.20	9.7± 1.76	11.2± 1.35	*	*	*	*
T_8	0	2.3±.45	3.7± 0.22	5.1±0.96	7.4± 1.99	8.6± 1.26	8.9± 1.04	9.8± 1.79	11± 1.94	*	*	*
T_9	0	3.4±.45	6.8± 0.54	8.9±1.19	10.3± 149	10.8± 1.8	11.4±1.73	11.9± 1.36	*	*	*	*
T_{10}	0	3.2±.33	5.5± 0.77	6.9±0.59	8.8± 1.11	9.6± 1.02	11.1±1.39	11.7± 1.30	12.3±1.23	*	*	*
T_{11}	0	3.6±.38	3.9± 0.18	4.7± 0.06	5.4± 1.20	6.9± 1.72	8.1± 1.83	10.2± 1.88	13.2±	*	*	*
T_{12}	0	2.8±.33	3± 0.17	3.7± 0.88	4.8± 2.0	5.5± 1.25	7.7± 1.33	9.2± 1.27	9.9± 1.44	12.1±1.80	*	*
T_{13}	0	3.3±.35	6.4± 0.77	9.7± 0.28	11.8±1.88	*	*	*	*	*	*	*
T_{14}	0	3.9±.45	5.3± 0.35	8.5± 0.88	10.6±2.11	12.3± 1.49	*	*	*	*	*	*
T_{15}	0	3±.55	5.2± 0.44	7.8± 0.48	9.9± 1.59	11.1± 1.67	12± 1.70	*	*	*	*	*
T_{16}	0	3.4±0.55	5.6± 0.63	7.5± 0.33	8.7± 1.97	9.5± 1.00	10.9±1.29	12.8± 1.88	*	*	*	*

Each value is the average of three determinations and expressed as Mean±SD.

* Spoiled/Not suitable for estimation

T_0: Control $T_1$to T_{16}: 1-MCP Treatment

Table 6 shows that tomato fruits treated with 1-MCP at 2.0µl/L concentration exposed for 24 hr at 20^oC storage temperature found highest shelf life of 33 days along with gradual increase in PLW (%) from 0 to 7.4% as compared to the rest of treatments of 0.5,1.0,1.5µl/L concentration for 24 hr exposure time at 20^oC and control fruit in which PLW (%) was increased from 0 to 9.3, 0 to 9.9, 0 to 10.1 and 0 to 11.3 % in 24,27, 30 and 12 days respectively. The present result founds close proximity with (18,19,20).

CONCLUSIONS

The present study revealed that, shelf life and the quality of tomato fruit was having strong association with 1-MCP concentration and its exposure time. The shelf life of tomato fruit (Cv. US-440) was increased with increase in concentration of 1-MCP and its exposure time and also the physicochemical properties, such as physiological loss in weight of fruit, colour, total soluble solids, Acidity and ascorbic acid content was significantly influenced by 1-MCP concentration and its exposure time. Fruits treated with 2.0µlL 1-MCP concentration for 24 h exposure time and stored at 20 °C storage temperature, found the best results in terms of physicochemical quality and highest shelf life of 33 days.

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Change in Colour of Tomato Fruits Cv. US-440 During Storage Period

Control fruits stored at Room Temperature



0 day **5th day** **9th day**

Fruits treated at 2000 ppb 20 °C for 24 hr exposure time




0 day **11th day** **22nd day** **33rd day**